

## Nectar host plant selection and floral probing by the Indian butterfly *Danaus genutia* (Nymphalidae)

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**Abstract:** Visitation frequency of the butterfly (*Danaus genutia*) to four species of nectar host plant species: *Nerium oleander* (L.) Blanco, *Barleria cristata rosea* L., *Crotalaria juncea* L., and *Bauhinia purpurea* L. was determined throughout the day light period of flight over 48 days during a time of maximum population density. The observations showed that the highest number of butterfly visits per hour occurred during 11.00 – 12.00 a.m. period, with the next highest number occurred during 10.00 – 11.00 a.m. period. Among the four plant species studied, *C. juncea* flowers were preferred by the butterfly as mean number of visits were significantly highest across all the time intervals recorded. Lastly, it was also found that the time spent during single visit by the butterfly was greater on unopened flowers than on open flowers of *C. juncea*. However, the maximum time, spent on unopened (41.0 seconds) and opened (20.1 seconds) *C. juncea* flower was found to be the highest of all other tested nectar host plants.

**Key words:** *Bauhinia purpurea*, *Barleria cristata rosea*, *Crotalaria juncea*, *Danaus genutia*, meal size, nectar host plant, *Nerium oleander*, probing behaviour.

## INTRODUCTION

Adult butterflies are considered opportunistic foragers that visit a wide variety of available flowers (Courtney 1986). However, in studies conducted to date, observed species have shown distinct flower preferences that can differ between them (Erhardt & Thomas 1991). Under any circumstances nectar resources for adults are likely important limiting factors (Gilbert & Singer 1975) and may shape community patterns (Gilbert 1984). In the present investigation, the preference of nectar host plants and probing behavior of the common tiger butterfly, *Danaus genutia* (Cra.m.er), were studied in a florally rich area of Northeast India. The example is of interest since this is an area of high biodiversity in contrast to most temperate sites.

## MATERIALS AND METHODS

### Site of observation and species

Our study site was located in the Kaziranga National Sanctuary. The reserve covers 430 sq. km. in Golaghat district, Assam, India (longitude 90°50'W to 90°40'E and latitude 26°30'S to 25°45'N). The site encompassed 500 sq m located 8 km South East of Bokakhat, the nearest town and bordered by Dhansiri river in the east. The site has high diversity and exhibits an especially rich flora with both abundant nectar and larval food plants. The common tiger butterfly, *Danaus genutia*, flies in abundance.

We designed our study to determine if there is a preferred nectar host plant among four flowering plant species that are known rich nectar sources: *Nerium oleander*, *Barleria cristata rosea*, *Crotalaria juncea*, and *Bauhinia purpurea*. Four patches of the flowering plants,

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each in close proximity were delimited to facilitate efficient observations (map, Fig. 1).

### Field observations

The study was performed in two stages. The first was to determine whether the four frequently used nectar sources were selected at random. If the null hypothesis is rejected, a pattern of preference should be quantitatively revealed.

For this first stage, a total of 30 individual flowers were marked on 10 randomly distributed plants of each species. Therefore, a total 120 flowers were sampled each day for each of the four species of plants. Observations were taken on the number of butterfly visits to each marked flower hourly from 6 a.m. to 5 p.m. throughout the day. The observations were made at 4 day intervals for the period, November 10 to December 26, 2000. The period includes the flowering time for these plant species. A total of 12 observation days were completed. Prior to each day sampling a fresh set of flowers were marked. Data thus obtained on visitation frequency on the different plant species was analysed using the fractional split plot design with 30 replications each. The plant species showing the significantly highest mean

number of butterfly visit per defined the favored host plant.

A second set of observations was restricted to *Crotalaria juncea*, which was shown by the initial study to be the preferred nectar source. For this study, 10 flowers each of open bloom and unopened bloom (one day ahead of bloom) were marked at random. The duration of time spent by the butterfly in a single trip on open or closed flowers individually was recorded. The work was done on hourly basis from 6 a.m. to 5 p.m. at the same periodicity as above.

### Statistical analysis

Significance amongst the species with respect to number of butterflies visits to flowers and visiting time on the four nectar host was evaluated by F-test as outlined by Bhattacharyya (Bhattacharyya 1999). Accordingly, standard error differences (SEd  $\pm$ ) were calculated using:

$$\text{SEd } (\pm) = \frac{\sqrt{(\text{error MS } X^2 / \text{pool number of replication})}}{}$$

Critical differences (CD at 5%) were calculated to test the differences amongst the nectar hosts and visiting times of the butterflies as,

$$\text{CD } (5\%) = \text{SEd } (\pm) \times t$$

where  $t$  is 5% tabulated value of 't' at error degree of freedom.

### RESULTS

Table 1 presents both frequency and total number of butterfly visits to each of the four nectar host plant species during different times of day. The highest frequency of visits to *C. juncea*, *N. oleander*, *B. cristata rosea*, and *B. purpurea* were observed to be 33.8, 13.6, 13.0, and 11.6 during the 11 – 12 a.m. interval followed by 31.9, 13.2, 11.6, and 9.2 during the 10 – 11 a.m. interval respectively. The total number of butterfly visits corresponded to frequency and was also higher during these periods of observation. Table 1 clearly shows that the frequency of butterfly visits to all plant species increased from morning to midday (11 – 12 a.m.), then decreased with the resulting lowest numbers during 4 – 5 p.m. interval. The frequency of

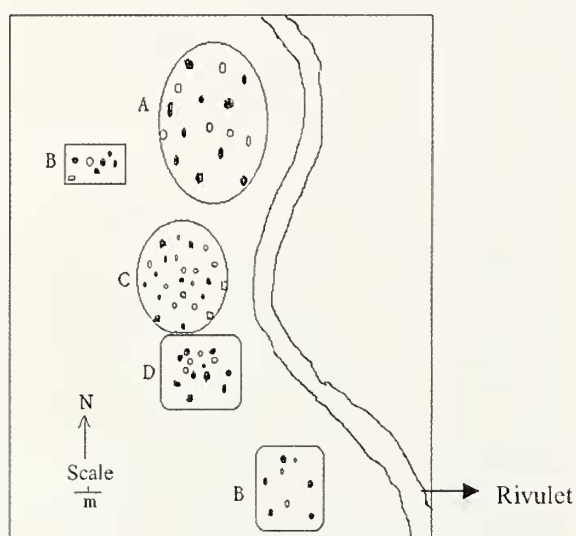


Fig. 1. Map showing distribution of the plant species in the study area giving number of individuals of those sampled. A - *Bauhinia purpurea*, B - *Crotalaria juncea*, C - *Barleria cristata rosea*, D - *Nerium oleander*. (opaque dots indicate individuals with flowers sampled)

**Table 1.** Mean and total number of visits (total of all observations) of *Danaus genutia* on the four different nectar host plants at different times of the day.

Time period	Plant species				
	<i>Crotalaria juncea</i>	<i>Nerium oleander</i>	<i>Barleria cristata rosea</i>	<i>Bauhinia purpurea</i>	Total
6-7 am	<b>4.36</b> 53	<b>2.93</b> 35	<b>2.13</b> 26	<b>2.53</b> 30	<b>11.95</b> 144
7-8 am	<b>5.50</b> 66	<b>3.83</b> 46	<b>2.47</b> 30	<b>2.97</b> 36	<b>14.77</b> 178
8-9 am	<b>6.47</b> 78	<b>3.60</b> 43	<b>3.07</b> 37	<b>3.93</b> 47	<b>17.07</b> 205
9-10 am	<b>13.40</b> 160	<b>8.77</b> 105	<b>6.33</b> 76	<b>5.93</b> 71	<b>34.43</b> 412
10-11 am	<b>31.87</b> 382	<b>23.20</b> 278	<b>11.63</b> 140	<b>9.23</b> 111	<b>75.93</b> 911
11-12 am	<b>33.87</b> 406	<b>13.60</b> 164	<b>13.03</b> 156	<b>11.60</b> 139	<b>72.10</b> 865
12-1 pm	<b>9.97</b> 120	<b>7.90</b> 95	<b>7.00</b> 84	<b>6.60</b> 79	<b>31.47</b> 378
1-2 pm	<b>6.03</b> 72	<b>5.03</b> 60	<b>4.40</b> 52	<b>3.57</b> 43	<b>19.03</b> 227
2-3 pm	<b>10.83</b> 130	<b>4.07</b> 49	<b>3.97</b> 48	<b>4.10</b> 49	<b>22.97</b> 276
3-4 pm	<b>8.00</b> 96	<b>2.80</b> 34	<b>3.17</b> 37	<b>2.40</b> 29	<b>16.37</b> 196
4-5 pm	<b>4.13</b> 50	<b>2.53</b> 30	<b>2.67</b> 32	<b>2.35</b> 28	<b>11.68</b> 140
Total	<b>134.43</b> 1613	<b>78.26</b> 939	<b>59.87</b> 718	<b>55.21</b> 662	<b>327.77</b> 3932

\* Bold numbers signify the frequency of visit of butterfly/day of respective hour

\*\* Normal letter signify the total number of visits of butterfly in respective hour during the observation period.

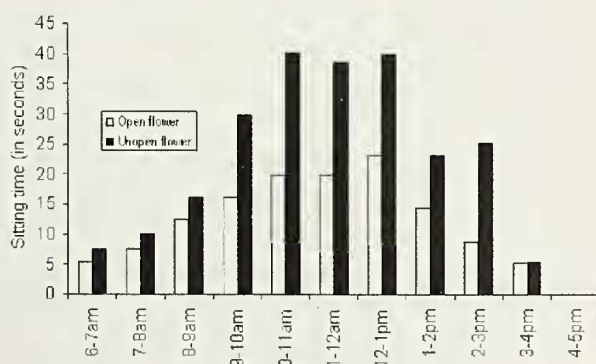


Fig. 2. Duration of visitation times of *D. genutia* at hourly intervals comparing visits to both open and unopened flowers of *Crotalaria juncea*.

visits was highest for *C. juncea* (33.9 and 31.9), followed by *N. oleander* (13.6 and 13.2), and lowest for *B. purpurea* (11.6 and 09.2) during 11 – 12 a.m. and 10 – 11 a.m. intervals respectively.

### Studies on time spent on single trip

In respect of time spent by butterfly in a single visit to a flower of the favored nectar host plant, *C. juncea*, it was observed that duration of a single visit increased to mid-day and gradually decreased later in the day (Fig. 2).

It is clear from Fig. 2 that *D. genutia* spends more time on unopened flowers, by comparison to open flowers, at any time of the day. The highest visit



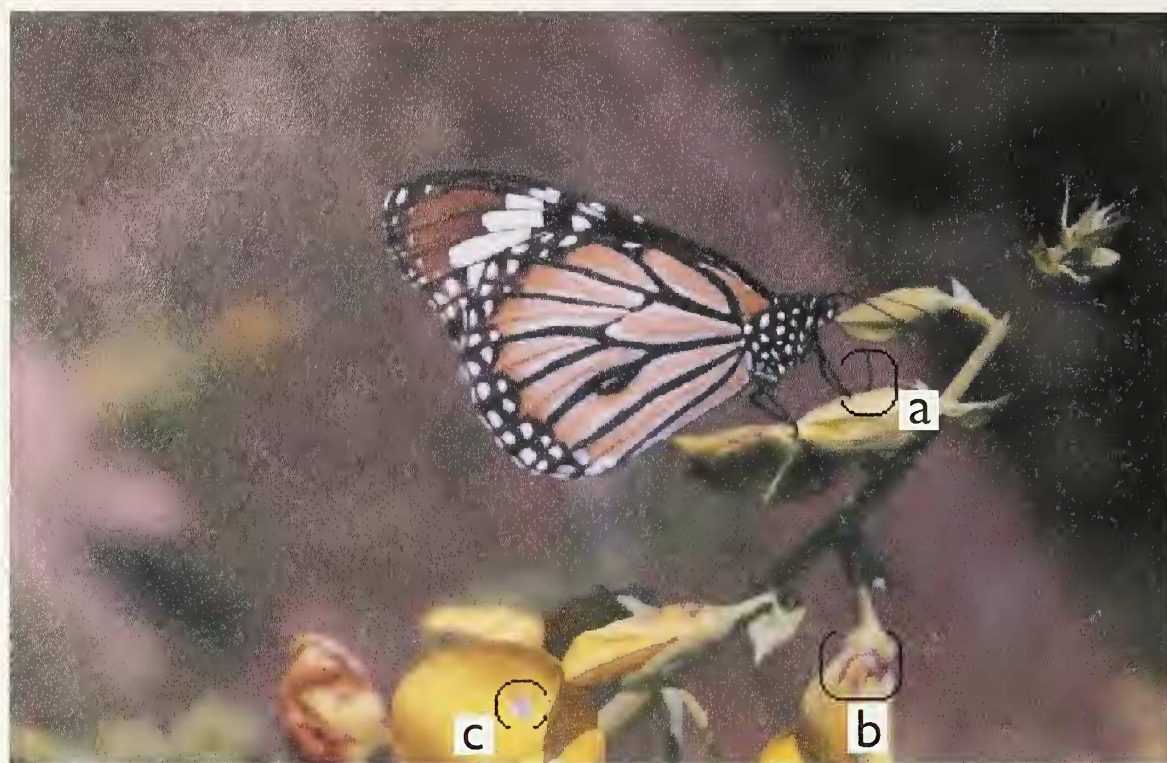


Fig. 3. Image showing *D. genutia* collecting nectar from unopened flower bud of *Crotalaria juncea*. a – butterfly probing by proboscis on unopened flower; b – piercing site on unopened flower; c – peircing hole on unopened corolla observed after complete bloom.

duration for a single trip to an open or unopened flower was found respectively to be 20.1 and 41.0 seconds during the 10–11 a.m. interval and 21.6 and 40.5 seconds during the 12–01 p.m. interval. After visiting an unopened flower, most butterflies immediately proceeded to probe with their proboscis and penetrate the sealed corolla to imbibe nectar (Fig. 3)

## DISCUSSION

As diurnal animals, butterfly foraging activity largely depends on temperature and intensity of light. The favored time period found in the present experiment likely is the result of an optimum temperature and intensity of incident light required for highest activity of the butterflies.

The flowers of most of the plant species are believed to be adapted to attract restricted groups of pollinators. For a large pollinator as a butterfly, a flower must offer a reasonable reward, yet may physically restrict access to the reward. Access may be limited by complex flower structure demanding

particular foraging skill (Slater & Neill 1986). This character of the flowers of *Crotalaria juncea* might be adapted to provide ease in perching for collection of nectar by the butterfly.

In respect to time spent by a butterfly during a single visit to a flower of the favoured nectar host plant (*C. juncea*), it was observed that duration of the visit increases from early morning to mid day followed by a gradual decrease visitation duration (Fig. 1). This effect might be due the nectar intake rate increases as the viscosity of nectar decreases with rising temperature as the day progresses as shown in another species by Pivnick & Neil (1985).

We also show that *D. genutia* spends more time on unopened compared with completely open flowers during all time periods. The cause of differences of sitting time during a single trip of the butterfly might be due the unopened flower providing a larger and fresher resource of nectar for the butterfly. Unopened flowers would be more attractive and justify the added energy required to access such nectar. The sitting time on unopened flower would be consequently be of longer duration because of added time needed to puncture the corolla.

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